

REMARKS

This amendment is in response to the Office Action dated December 5, 2008 (the Action).

I. Status of the Claims

Claims 1-11, 13-23 and 25-27 stand rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,285,502 to Walton (Walton) in view of U.S. Patent No. 4,490,585 to Tanaka (Tanaka). Claims 12 and 24 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Walton and Tanaka in further view of U.S. Patent No. 4,109,107 to Boast (Boast).

Reconsideration is respectfully requested in view of the above amendments and the remarks that follow.

II. The Section 103 Rejections

Independent Claims 1, 14, 26 and 27 have been amended to clarify that the audio signal is selectively modified in response to the signal strength information "to adapt the frequency response of the audio signal to the electromechanical properties of the electromagnetic transducer." Support for the above amendments can be found, for example, in paragraph [0018] of the published application (page 4, lines 27-30 of the originally filed specification).

Accordingly, Claim 1 recites as follows:

A control circuit for a signal strength information dependent frequency response adaptation of an audio signal for an electrodynamic transducer, the circuit comprising:

- a signal strength information determination means for determining a signal strength information according to a level of the audio signal, and

- a frequency modifying means for selectively modifying the audio signal in response to the signal strength information to adapt the frequency response of the audio signal to the electromechanical properties of the electromagnetic transducer such that the electrodynamic transducer converts the audio signal into a low distortion sound signal for high levels

of the audio signal and has a flat frequency response for low levels of the audio signal,
wherein a lower frequency range of the audio signal is modified with a gain that is different than a gain of a higher frequency range of the audio signal, and a cutoff frequency separating the lower frequency range from the higher frequency range is shifted towards higher values for an increasing level of the audio signal and towards lower values for a decreasing level of the audio signal.

Independent Claim 1 recites that the audio signal is modified so that the electrodynamic transducer converts the audio signal into a low distortion sound signal for high levels of the audio signal and so that it has a flat frequency response for low levels of the audio signal. As discussed in Applicant's specification, embodiments of the invention achieve a good sound quality and a high dynamic range even with a relatively small electrodynamic transducer. *See* paragraph [0012]. Accordingly, the above amendment further clarifies that the frequency response of the audio signal is adapted to the electromechanical properties of the electromagnetic transducer. In contrast, Tanaka and Walton concern noise suppression in a hearing aid.

For example, the Action takes the position that Walton discloses that the audio signal is modified so that the electrodynamic transducer converts the audio signal into a low distortion sound signal for high levels of the audio signal and so that it has a flat frequency response for low levels of the audio signal in column 4, lines 47-59 and column 5, lines 6-13. *See* the Action, page 2. However, in Walton, the characteristics of the audio signal are modified based on the sound energy in the low frequency spectrum of the audio signal corresponding to noise. *See* col. 5, lines 6-13 (cited in the Action). In Walton, an attenuation of the frequency range corresponding to the noise is performed for high levels of the audio signal. However, Claim 1 recites that the electrodynamic transducer converts the audio signal into a low distortion sound signal for high levels of the audio signal and has a flat frequency response for low levels of the audio signal. Accordingly, Applicant submits that these features are not disclosed by the techniques in Walton, which involve modifying the audio signal based on the sound energy in the low frequency spectrum of the audio signal corresponding to noise.

In addition, Applicant submits that Walton does not propose how to reduce distortion in an audio signal, *e.g.*, when a transducer is driven close to the limit of the membrane oscillation amplitude with a high level audio signal because Walton only deals with the removal of a noise component of an audio signal that is reproduced with a relatively constant volume for a hearing impaired person. Accordingly, there is no motivation to arrive at the recitations of the current claims based on Walton.

Tanaka, which is cited on page 3 of the Action as allegedly disclosing a cutoff frequency of a frequency modifying means that is shiftable, does not provide the missing elements of Walton noted above. Tanaka similarly relates to a hearing aid with an automatic noise suppressor and a filter for reducing unwanted low frequency components, *i.e.*, noise components. Thus, Tanaka also does not disclose that the electrodynamic transducer converts the audio signal into a low distortion sound signal for high levels of the audio signal and has a flat frequency response for low levels of the audio signal as recited in Claim 1.

In addition, Walton actually discusses the techniques proposed by Tanaka and states as follows (emphasis added):

Audio processing devices have also been designed to attenuate low frequencies of sound as a function of noise energy. For example, U.S. Pat. No. 4,490,585 to Tanaka discloses a hearing aid in which a low frequency component of ambient sound is used to shift a cut-off frequency of a high pass filter. An increasing level of the low frequency sound is used to shift the cut-off frequency up to 1.5 kilohertz for attenuating loud noises within the low frequency spectrum. However, important speech information is also conveyed at frequencies much less than 1.5 kilohertz, and shifting the cut-off frequency of the high pass filter through the cut-off frequency of the high pass filter through this region reduces speech intelligibility as well as noise.

Walton further states in column 5, lines 27-37 that "the cut-off frequency preferably remains constant while the slope of the response curve is varied. Significant shifts in the cut-off frequency would undesirably attenuate frequencies containing important speech information." Therefore, Walton **teaches away** from a combination with the shifting cut-off frequencies in Tanaka.

Moreover, even if the disclosures of Walton and Tanaka were combined, Applicant submits that the combination would merely filter out low frequency noise from a recorded audio signal based on an energy level of the noise component of the audio signal. In contrast, Claim 1 recites that the frequency response of the audio signal is adapted to the electromechanical properties of the electromagnetic transducer. Walton and Tanaka do not disclose this recitation alone or in combination.

Boast also does not provide the elements missing in Walton and Tanaka. Boast relates to compensating an audio signal for the frequency response of a loud speaker. Boast proposes that the frequency response of the loudspeaker is compensated by three separate networks having frequency characteristics curves which are complementary to the frequency characteristics of the loudspeaker. The system achieves a "substantially uniform audio output over the desired frequency range," as stated in the Abstract and in column 2, lines 24-28. Such compensation results in a velocity of the diaphragm or cone of the loudspeaker that is substantially uniform over the frequency range of interest. *See* column 1, lines 52-54. However, if the technique proposed by Boast were applied to a small electrodynamic transducer, the reproduction of a high level audio signal would be highly distorted, as the oscillation amplitude of the membrane of such a small-sized transducer is limited. Distortions and clipping which can occur at high membrane oscillation amplitudes result in a poor sound signal quality and may even lead to a damaging of the small-sized transducer.

In addition, Applicant submits that Boast compensates the audio signal based on the properties of a specific loudspeaker, and compensates the audio signal for the frequency response of a loud speaker. In contrast, the current claims recite modifying the audio signal in response to the signal strength information. For example, Claim 1 recites modifying the audio signal in response to the signal strength information to adapt the frequency response of the audio signal to the electromechanical properties of the electromagnetic transducer, and this recitation is not disclosed or rendered obvious by the frequency response compensation in Boast, which aims to achieve a "substantially uniform audio output." *See* column 2, lines 24-28.

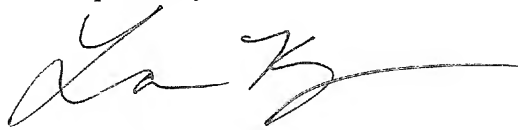
Attorney Docket No. 9733-10
Application Serial No. 10/522,857
Filed: September 26, 2005
Page 12

For at least the reasons discussed above, Walton, Tanaka and Boast do not disclose or render obvious the recitations of Claim 1. Independent Claims 14, 26 and 27 include analogous recitations to those discussed with respect to Claim 1 above. Claims 2-13 and Claims 15-25 depend from Claims 1 and 14, respectively, and are patentable by virtue of the claims from which they depend. Accordingly, Applicant requests that the rejection of Claims 1-27 be withdrawn.

CONCLUSION

Accordingly, Applicant submits that the present application is in condition for allowance and the same is earnestly solicited. Should the Examiner have any small matters outstanding of resolution, he is encouraged to telephone the undersigned at 919-854-1400 for expeditious handling.

Respectfully submitted,



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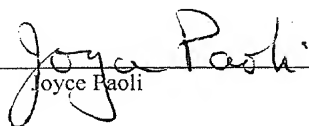
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Attachments

CERTIFICATION OF TRANSMISSION

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Joyce Paoli